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**CORRECTIVE MEASURES STUDY (CMS)
SURFACE RUNOFF TO THE TRIBUTARY (AOC 14)**

**OCCIDENTAL CHEMICAL CORPORATION
DELAWARE CITY, DELAWARE**

**Prepared By:
GLENN SPRINGS HOLDINGS INC.**

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**Conestoga-Rovers
& Associates**

410 Eagleview Blvd., Suite 110
Exton, PA 19341
Office: (610) 321-1800
Fax: (610) 321-2763

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4.32 SURFACE RUNOFF TO THE TRIBUTARY (AOC 14)

4.32.1 OVERVIEW

Description

AOC 14 (Surface Runoff to the Tributary) is located between the Process Area and the Tributary. Figure 4.32.1 presents a location map with the current topography. There have been no active operations or disposal in AOC 14; however, the soil/sediments in AOC 14 have been impacted by runoff from the plant. During the investigation of AOC 8 (the Tributary) the potential for the transport of mercury-impacted soils to AOC 8 via surface water runoff was identified as a concern. Therefore, AOC 14 was created to assess the potential for a mercury source that may contribute to AOC 8. Other metals are present in the Tributary sediments but at much lower levels in comparison to screening levels. VOCs are not a concern as VOCs are not being transported to the Tributary via surface water runoff at levels of concern.

AOC 14 is primarily comprised of a phragmites marsh (north portion), and also by an upland area (southern portion), and drainage ditches along Haul Road. In general the area is north of AOC 10 (the Former Lay Down Area) and SWMU 12 (the Chemfix Test Unit), and the Plant Process Area (AOC 5).

History

Surface water and soil runoff pathways from the plant to the marsh area north of the plant have existed since plant construction. Regrading during plant expansion and construction has altered the configuration of many of the runoff pathways. However, review of historical photographs suggest there has been little change in runoff pathways since the formation of AOC 8 around 1987.

Since no plant operations were ever performed in AOC 14, mercury-laden sediments would have to originate from upgradient sources (e.g., AOC 6 (Stormwater Drainage Channels and Outfalls), AOC 10 (Former Lay Down Area), and SWMU 6 (Stormwater Drainage Pond)).

In 1997, organic and inorganic compounds were detected in several drainage ditches that carried runoff from the Process Area to the marsh area and Tributary. An investigation of the ditches (AOC 6) was completed in 1998. The Process Area drainage ditches that flowed to Outfall 006 were remediated as part of the Ditch Sediment IM in 2001. Soil samples from the drainage ditches had elevated mercury concentrations prior

to the IM. Post-excavation samples were collected in October 2001 from the ditches; mercury concentrations ranged from less than 1 mg/kg up to 72 mg/kg.

Investigation of AOC 10 during 2006 identified high mercury levels in the surficial soils. Mercury concentrations in surficial soils ranged from less than 0.1 mg/kg to 459 mg/kg. The 2006 investigation of AOC 10 identified soil transport from AOC 10 to AOC 14 as a potential concern. The Corrective Action Objectives for AOC 10 address the runoff from AOC 10 (see Section 4.28.7) to AOC 14 and the Tributary, and temporary silt fencing has been installed to mitigate current migration.

Investigation of SWMU 6 (Stormwater Drainage Pond) in 2006 identified low mercury levels in surface soils. In general, mercury concentrations diminish with depth and appear to be higher within the eastern end of the unit.

In 2007, soil, sediment, and surface water samples were collected within discrete surface water runoff pathways within AOC 14. Soil and sediment samples were also collected within AOC 14 outside the discrete pathways for comparison. Sediment and surface water samples were also collected during the 2007 investigation of the AOC 12 marsh area. The mercury results from those samples were considered in evaluation of AOC 14. Sediment and surface water samples were also collected within a drainage pathway north of Outfall 003 during the investigation of SWMU 6 (Former Stormwater Drainage Pond). These samples are also considered here as part of AOC 14.

Current Status

AOC 14 remains unused, and is covered with trees and/or phragmites. Based on the 2007 investigation results, AOC 14 is not an ongoing source of mercury to the Tributary.

4.32.2 SUMMARY OF SWMU DOCUMENTATION

Table 4.32.1 presents a list of the documents that were reviewed and considered in the assessment of AOC 14.

4.32.3 RELEVANT DATA

This section presents a summary of the data considered by the CMS for AOC 14. Table 4.32.2 lists the relevant sample locations for AOC 14 and Figure 4.32.2 presents the sample locations. Figure 4.32.3 presents a 2007 aerial photograph.

4.32.3.1 SOIL

Three surficial soil samples were collected north of AOC 10 and SWMU 12 during the 2006 investigation of AOC 10. These samples were collected on dry land and not within any drainage feature. Nine additional surficial soil samples collected during the 2007 additional sampling effort; five samples were collected along the Haul Road, and four samples were collected in the wooded area north of SWMU 12 and AOC 10. Of these last four, two were located within drainage pathways, and two were collected as random samples. The soil sampling locations are shown on Figure 4.32.2. All twelve samples are considered relevant for AOC 14.

4.32.3.2 WASTE

There are no wastes in AOC 14.

4.32.3.3 GROUNDWATER

No groundwater samples were collected in AOC 14. Groundwater beneath the western portion of AOC 14 is considered part of AOC 9 and AOC 12 and is addressed in those sections of the CMS Report. Groundwater beneath the eastern portion of AOC 14 is part of AOC 12 and AOC 7 and is addressed in those sections of the CMS Report.

4.32.3.4 SEDIMENT

A total of 17 sediment samples were collected in AOC 14. Two were collected northeast of AOC 10 during the 2006 investigation of AOC 10 (FLD-32 & FLD-33). Both samples were located on the marsh surface in discrete drainage pathways. In 2007, 15 sediment samples were collected during the additional sampling effort in the marsh area. Eleven of these were collected from discrete pathways that drain to AOC 8 (via Outfall 003, Outfall 006, and the ditch). Four additional samples were collected at random on the marsh surface from material defined by GSHI as the Shallow Marsh Sediments (MS-01 to MS-04). The locations of all of the sediment samples are shown on Figure 4.32.2.

4.32.3.5 SURFACE WATER

Surface water samples were collected from the ditch and a seep just to the east of AOC 10. The ditch locations were sampled twice to capture high and low flow conditions. In total, seven surface water samples were collected in AOC 14. The locations of all of the surface water samples are shown on Figure 4.32.2.

4.32.4 RISK SCREENING

There are no human or ecological exposure pathways in AOC 14. Thus, there are no applicable screening criteria for soil, sediment or surface water. These data are evaluated in subsequent sections.

4.32.5 IDENTIFICATION OF KEY COCS

AOC 14 was investigated to determine whether or not the area was contributing mercury to the Tributary surface water at levels in excess of the total mercury cleanup goal. Thus, by definition mercury is the Key COCs in AOC 14.

Soil

The soil samples were compared to the 10 mg/kg sediment mercury criterion established for AOC 8. Sample results ranged from 0.24 to 20.6 mg/kg. Of the twelve soil samples collected, one exceeded the 10 mg/kg mercury cleanup goal established for the Tributary.

Sediment

The sediment samples collected from discrete drainage pathways were compared to the 10 mg/kg sediment mercury criterion established for AOC 8. Sample results ranged from 0.104 to 146 mg/kg. Of the seventeen sediment samples collected, eight exceeded the 10 mg/kg mercury cleanup goal established for the Tributary. Figure 4.32.4 presents a dot-plot of mercury results for sediment samples.

Surface Water

The dissolved mercury results for the surface water samples were compared to the 0.77 ug/L surface water mercury criterion established for AOC 8. Six of the seven results

were non-detect (<0.1 ug/L). The detection was in the Row D sample collected in May 2008 had 0.11 ug/L of dissolved mercury, well below the screening criterion. Note that the surface water (seep) sample collected to the east of AOC 10 was one of the six non-detect sample results. Thus, the surface water sampled in AOC 14 will not adversely impact AOC 8.

4.32.6 CONCEPTUAL MODEL

The Conceptual Model section lays the foundation for the development of remedial actions. The discussion considers mercury and the potential exposure pathways identified above.

AOC 14 encompasses approximately five acres and is located on the north side of the Process Area. With the exception of the drainage ditches along Haul Road, AOC 14 is entirely within an undeveloped area of the OxyChem property.

The transport of mercury through and from AOC 14 to AOC 8 is a result of erosion, suspension, and transport of the surficial soil and or sediment. The amount of transport is a function of precipitation, vegetative cover, and mercury concentration in the soil/sediment. There is sufficient precipitation and runoff during the year to fill drainage ditches and create overland sheet flow in many areas. The drainage ditches south of the marsh area are not vegetated. The slope north of the SWMU 12 and AOC 10 is poorly vegetated. In both areas the surficial soils in AOC 14 could be transported to AOC 8 under current conditions.

AOC 14 can be divided into three areas:

- Outfall 006 Drainage swales along the north and south sides of the Haul Road that drain to AOC 14;
- The upland area (steep, dry slope) north of SWMU 12 and AOC 10; and
- The AOC 12 marsh area, which is predominated with phragmites.

The potential for each of these areas to be an ongoing source of mercury to AOC 8 is discussed below.

Outfall 006 Drainage Swales and Haul Road Drainage Swales

In 2001, the Process Area drainage ditches were remediated as part of the Ditch Sediment IM. However, the IM did not address either the Outfall 006 drainage swales or the Haul Road drainage swales.

Historically, runoff from the far western side of the Process Area drained through Outfall 006 into a drainage swale (sample OF06-01), traveled about 400 feet eastward along the south side of Haul Road, then flowed northward beneath the Haul Road in a culvert pipe. On the north side of Haul Road, the pipe discharged into a small depression. Another pipe drained the depression and discharged into the marsh area (sample OF06-02). Prior to 1987, Red Lion Creek inundated the entire marsh area north of the plant and the discharge from Outfall 006 flowed directly into Red Lion Creek. Beginning around 1987 when water levels in Red Lion Creek lowered, the Outfall 006 discharge flowed into the phragmites marsh and then flowed through the marsh into the western end of AOC 8. Currently, runoff flow is restricted to a single, water-filled channel at the start of the marsh (OF06-02). This channel appears to be manmade. About halfway to AOC 8 (sample OF06-04) the channel disappears and flow spreads out within the marsh; a discrete channel is no longer apparent. Sample OF06-01 is dry except for brief periods following precipitation events and therefore is considered a soil sample. Samples OF06-02 to OF06-05 are normally wet and are considered to be sediment samples.

Drainage swales are located along the north and south sides of the Haul Road. These swales drain the road surface and adjacent unpaved areas. The southeastern swale was heavily modified during the construction of the Process Area barrier wall and collection trench in 2003/2004. Four samples were collected in these swales, DS06-01 to DS06-04. All four samples are normally dry and are considered to be soil samples. None exceeded the Tributary sediment cleanup goal (10 mg/kg).

Two of the four sediment samples, OF06-2 to OF06-5, in the Outfall 006 drainage pathway exceeded the Tributary sediment cleanup goal (10 mg/kg).

Area North of SWMU 12 and AOC 10

The area north of SWMU 12 and AOC 10 is wooded and slopes down to the marsh area. This area is not accessible for development. The soils appear to be composed of Columbia Sands and have been minimally disturbed by anthropogenic activities. In 2006, three soil samples were collected northwest of AOC 10 (FLD-30, FLD-34, and FLD-35). In 2007, two discrete runoff pathways were identified in the wooded area north of SWMU 12 and AOC 10. A surficial soil sample was collected in each pathway (WA-01 and WA-02). Two surficial soil samples were collected outside of the pathways (WA-03 and WA-04) for comparison. The mercury concentrations at all seven of the soil sample locations except FLD-35 were below 10 mg/kg. Therefore, the area north of SWMU 12 and AOC 10 is not considered a source to AOC 8.

AOC 12 Marsh Area

Thirteen sediment samples were collected in the AOC 12 marsh area, nine within discrete runoff pathways, and four at random on the marsh surface. Six of the 13 samples exceeded the Tributary sediment cleanup goal (10 mg/kg). The two highest mercury levels were found in samples collected in the runoff pathways from AOC 10 (FLD-31 and FLD-32). The third highest was in the ditch adjacent to AOC 10 (Row A Ditch Sediment). Based on these observations, abatement of soil erosion and runoff from AOC 10 is an important element in the long-term success of the AOC 8 remedy.

Samples MS-03 and MS-04 at the outlet of the current Outfall 003 exceed the 10 mg/kg cleanup goal. These are not in discrete runoff pathways; they may be related to historical discharges from Outfall 003 or Outfall 005. Under the current conditions, these sediments appear to be accumulating rather than being transported, therefore, do not represent a threat to the long-term success of the AOC 8 remedy. One of the four sediment samples collected within the discharge pathway from outfall 003 (OF003-3) exceeded the 10 mg/Kg cleanup criteria with a concentration of 15.6 mg/Kg. The remaining three locations were below the criteria.

Surface water samples were collected at three locations in the ditch and at the toe of the AOC 10 slope. No exceedences of the surface water criterion for mercury were identified.

Summary

Investigations in the Tributary identified mercury levels in sediment as high as 1,630 mg/Kg at STATION-G; the cleanup goal is 10 mg/Kg. Two possible sources for the mercury in Tributary sediments exist, mercury in: groundwater discharge and sediment transport via surface water runoff. The current mercury levels in the groundwater are not sufficient to explain the mass of mercury in the Tributary sediments. Conditions prior to Site investigations are unknown. Sediment runoff from the Plant's Stormwater Drainage Channels and Outfalls, AOC 6, was investigated in 1998 and remediation was completed in 2001. Thus, there is no continuing runoff of mercury-laden sediment.

AOC 14 (Surface Runoff to the Tributary) was investigated to address the hypothesis that it is a potential ongoing source of mercury to the Tributary (AOC 8) where ecological exposure pathways could occur. The investigation of AOC 14 was completed in 2007 and the results are documented in the January 2008 *Additional Data Collection Report*. Based on the investigation results, there is no indication of an ongoing source of

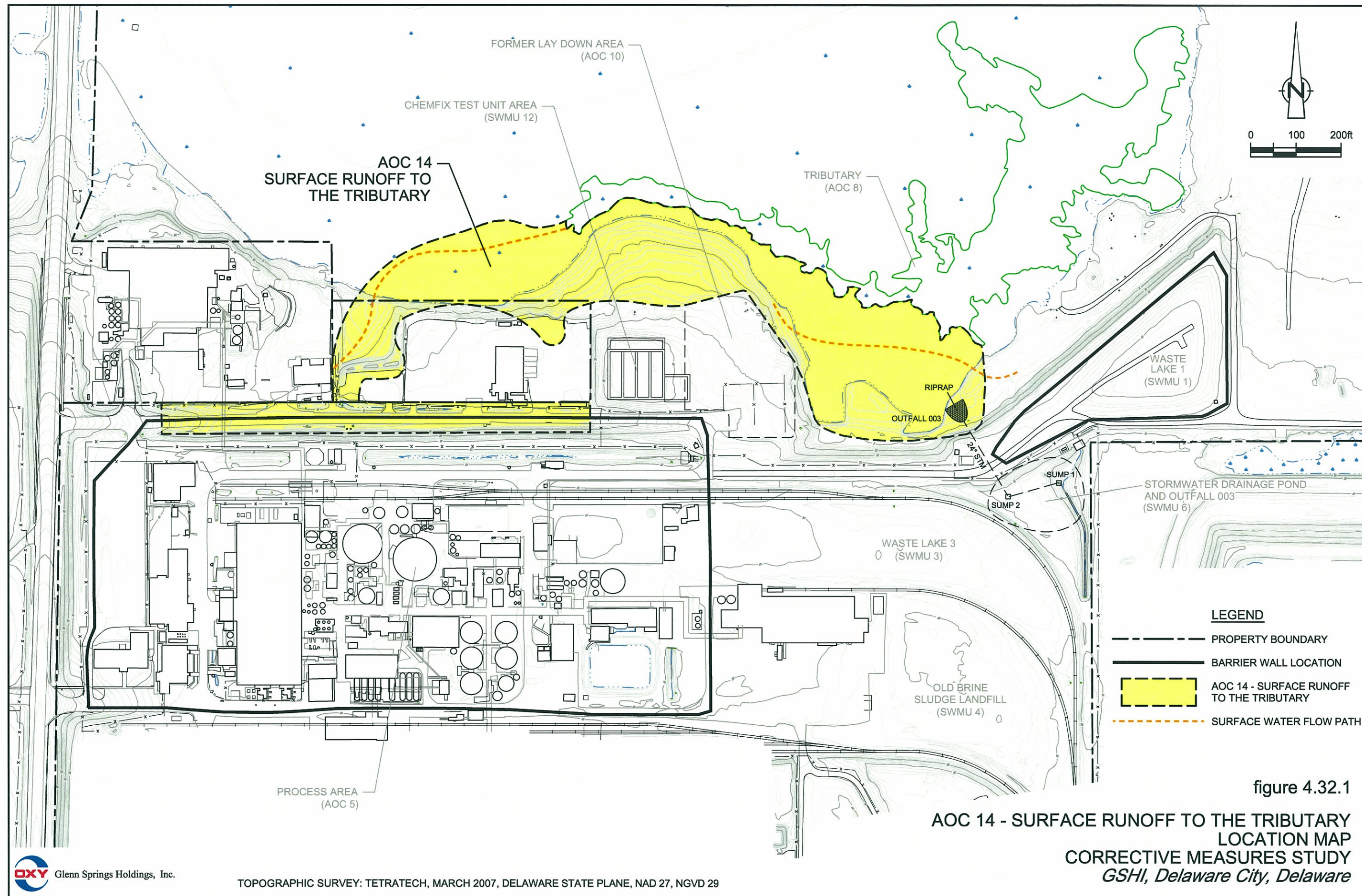
sediments with high mercury concentrations (compared to STATION-G), and AOC 14 is not considered a significant source of mercury-laden sediments. There are no ecological exposure pathways in AOC 14, and these sediment are not an immanent risk.

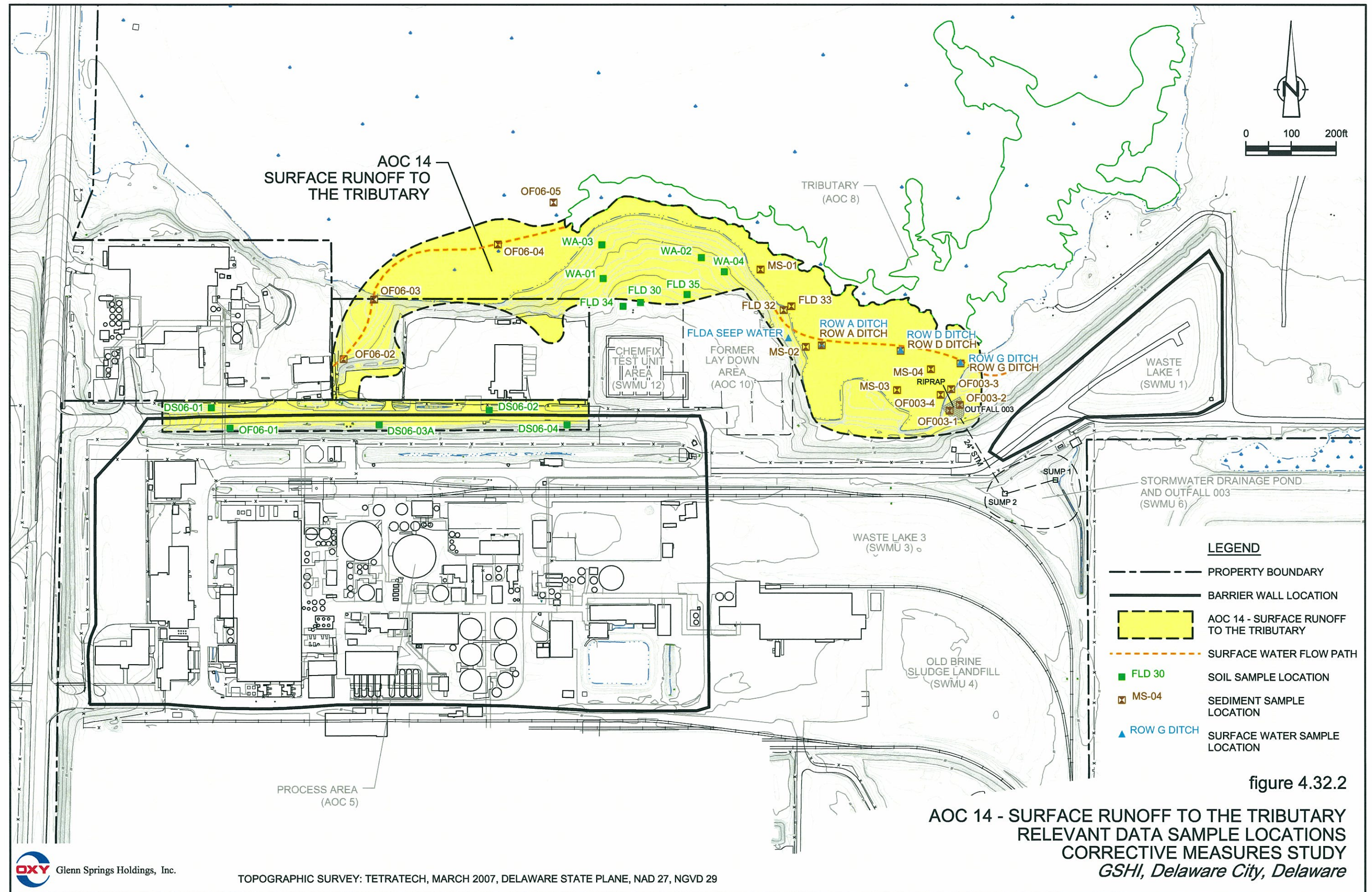
4.32.7 CORRECTIVE ACTION OBJECTIVES

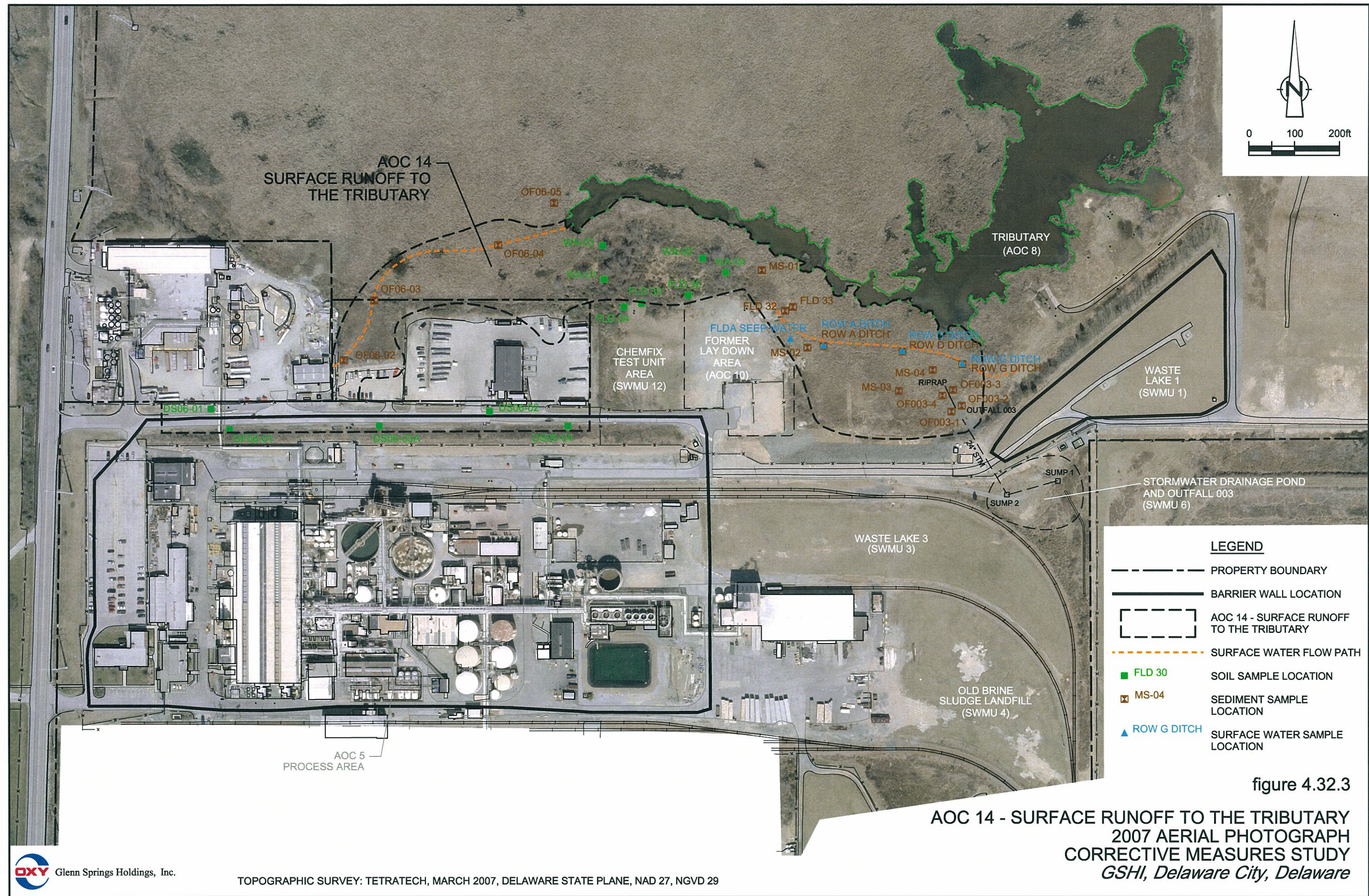
There are no corrective action objectives for AOC 14.

4.32.8 FINAL REMEDY EVALUATION

No further action is required for AOC 14.







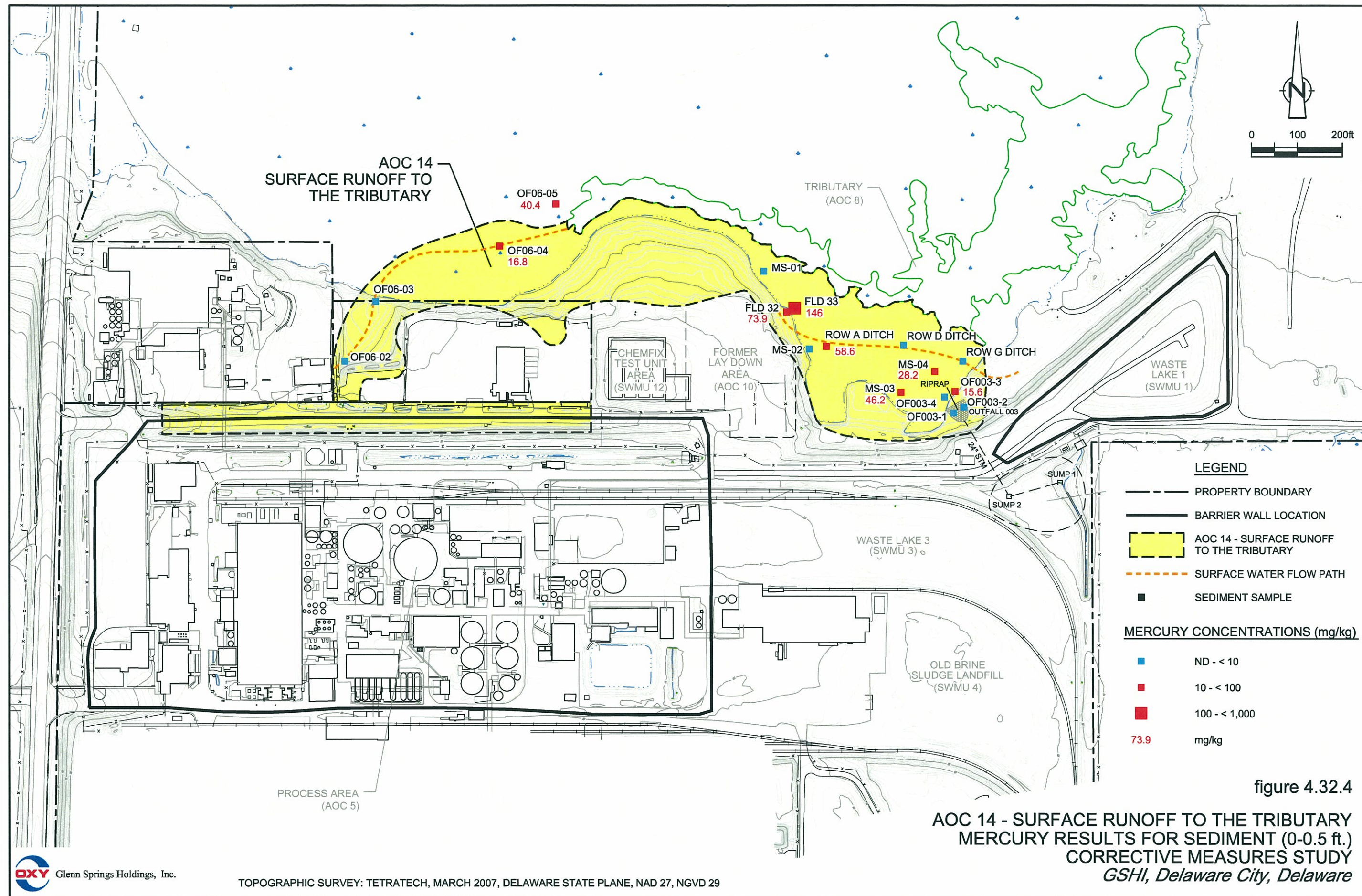


TABLE 4.32.1
AOC 14 – SURFACE RUNOFF TO THE TRIBUTARY
SUMMARY OF DOCUMENTATION
GLENN SPRINGS HOLDINGS, INC.
DELAWARE CITY, DELAWARE

Date	Memo/Report
March 2007	<i>Additional Sampling Work Plan (CRA Report 50)</i>
January 2008	<i>Additional Data Collection Report (CRA Report 51)</i>

TABLE 4.32.2
AOC 14 - SURFACE RUNOFF TO THE TRIBUTARY
RELEVANT SAMPLE LOCATIONS
GLENN SPRINGS HOLDINGS, INC.
DELAWARE CITY, DELAWARE

AOC	loc_name	sample_type	start_depth	end_depth	sample_matrix_code	sample_date	Compare to Cleanup Goal
AOC 14	DS06-01	N	0	0.5	Soil	5/10/2007	yes
AOC 14	DS06-02	N	0	0.5	Soil	5/10/2007	yes
AOC 14	DS06-03	N	0	0.5	Soil	5/10/2007	yes
AOC 14	DS06-04	N	0	0.5	Soil	5/10/2007	yes
AOC 14	FLD-30	N	0	0.5	Soil	9/11/2006	yes
AOC 14	FLD-34	N	0	0.5	Soil	9/11/2006	yes
AOC 14	FLD-35	N	0	0.5	Soil	9/11/2006	yes
AOC 14	OUTFALL-006-01	FD	0	0.5	Soil	5/10/2007	yes
AOC 14	OUTFALL-006-01	N	0	0.5	Soil	5/10/2007	yes
AOC 14	WA-01	N	0	0.5	Soil	5/10/2007	yes
AOC 14	WA-02	N	0	0.5	Soil	5/10/2007	yes
AOC 14	WA-03	N	0	0.5	Soil	5/10/2007	yes
AOC 14	WA-04	N	0	0.5	Soil	5/10/2007	yes
AOC 14	FLD-32	N	0	0.5	Sediment	9/11/2006	yes
AOC 14	FLD-33	N	0	0.5	Sediment	9/11/2006	yes
AOC 14	MS-01	N	0	0.5	Sediment	5/10/2007	yes
AOC 14	MS-02	N	0	0.5	Sediment	5/10/2007	yes
AOC 14	MS-03	N	0	0.5	Sediment	5/11/2007	yes
AOC 14	MS-04	N	0	0.5	Sediment	5/11/2007	yes
AOC 14	OUTFALL-003-01	N	0	0.5	Sediment	5/9/2007	yes
AOC 14	OUTFALL-003-02	N	0	0.5	Sediment	5/9/2007	yes
AOC 14	OUTFALL-003-03	N	0	0.5	Sediment	5/9/2007	yes
AOC 14	OUTFALL-003-04	N	0	0.5	Sediment	5/9/2007	yes
AOC 14	OUTFALL-006-02	N	0	0.5	Sediment	5/11/2007	yes
AOC 14	OUTFALL-006-03	N	0	0.5	Sediment	5/11/2007	yes
AOC 14	OUTFALL-006-04	N	0	0.5	Sediment	5/15/2007	yes
AOC 14	OUTFALL-006-05	N	0	0.5	Sediment	5/15/2007	yes
AOC 14	Row A Ditch Sediment	N	0	0.5	Sediment	7/30/2007	yes
AOC 14	Row D Ditch Sediment	N	0	0.5	Sediment	7/30/2007	yes
AOC 14	Row G Ditch Sediment	N	0	0.5	Sediment	7/30/2007	yes
AOC 14	FLDA seep water	N			Surface Water	9/10/2007	yes
AOC 14	Row A Ditch water	N			Surface Water	7/30/2007	yes
AOC 14	Row A Ditch water	N			Surface Water	9/10/2007	yes
AOC 14	Row D Ditch water	N			Surface Water	7/30/2007	yes
AOC 14	Row D Ditch water	N			Surface Water	9/10/2007	yes
AOC 14	Row G Ditch water	N			Surface Water	7/30/2007	yes
AOC 14	Row G Ditch water	N			Surface Water	9/10/2007	yes

Notes:

1. Relevant data is compared to the Cleanup Goal for soil, sediment and surface water.
2. N = Normal
3. FD = Field Duplicate